**Lightweight SPI Assessments:**

**What is the real Cost?**

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**Abstract**

In this paper we describe the implementation of an assessment method that was developed to assess software processes within small to medium-sized Irish software organisations that have little or no experience of software process improvement (SPI) programmes. We discuss the actual overheads associated with performing software process assessments based upon our experiences of performing assessments in three small to medium sized (SMEs) software development companies.

***1 Introduction***

For many small software companies, implementing controls and structures to properly manage their software development activity is a major challenge. A software process improvement (SPI) programme, properly managed and administered, can assist software companies in this regard. An SPI programme is best approached through the medium of a process assessment. Assessments help to highlight strengths and weaknesses in an organisation’s processes and, thereby act as a catalyst for the SPI initiative.

However, assessments are an expensive business and typically require significant company resources to achieve meaningful impact. As a result, and to enable small companies gain the benefits of SPI, in 2006 we created the Adept assessment method [1]. Based on Capability Maturity Model Integration (CMMI) Class ‘C’ appraisal guidelines [2] and incorporating practices from ISO/IEC 15504 [3], Adept offers a lightweight mechanism for commencing, or kick-starting, an SPI programme. At present, 3 assessments have been carried out using the Adept method. Whilst the results and feedback on the method itself support the authors’ beliefs that it has benefit for small companies, this paper reports on actual costs associated with performing this assessment within the three software SMEs.

This paper is structured as follows. Section 2 describes the software industry in Ireland including the types of companies that were assessed and provides an overview of the Adept method. Section 3 details the implementation of the Adept assessment within the three companies. Section 4 provides an analysis of the overheads associated with performing the assessments. Section 5 discusses the significance of these overhead costs and section 6 offers conclusions and a description of future work.

***2 Adept Assessments and the Irish Software Industry***

**2.1 The Irish Software Industry**

The software industry in the Republic of Ireland (ROI) is a key component of the national economy. According to Enterprise Ireland (EI) (ROI’s economic development agency for indigenous companies) at the end of 2004, Irish-owned software businesses comprised over 750 companies employing almost 12,000 people [4]. The majority of these Irish-owned software firms are small where it is calculated that only 1.9% employ more than 100 people whilst more than 60% employ 10 or fewer [5]. The venture capital group, HotOrigin produce an annual report on the state of the indigenous software industry and estimate there is a total of 417 indigenous software product companies in Ireland [6]. They categorise these companies across three stages of development, ‘Start-up’ (1-25 employees), ‘Build’ (26-75 employees), and ‘Expansion’ (75+ employees). The 2004 report shows that almost three-quarters of indigenous software firms fall into the Start-up category, with about 9% in the Expansion category and the remainder in the Build category.

The profile in Northern Ireland (NI) is similar. A Mintel study [7] on the software sector in NI showed that, at the beginning of 2005, there were 348 companies employing approximately 5,500 people. Of these 348, 71% are indigenous but account for only 12% of the staff. However, over 75% of the companies employ fewer than 15 people.

Because of the industry profile, and the prevalence of small and very small organisations, the need for an assessment method that requires very little client resources is clear. To support industry improvement, and to promote competitiveness and success of the indigenous software industry of the entire island of Ireland, both EI and Momentum (the Northern Ireland ICT federation) are currently engaging member companies in SPI initiatives.

This paper details how Adept assessments were performed in three indigenous software development organisations with the ROI. These companies employed approximately 5, 22 and 100 software developers and this therefore provides a good sample of Irish software SMEs. None of the companies had any prior experience of software process improvement or particularly of either SW-CMM or CMMI. The three companies also work in three different sectors namely, financial, medical and space technologies.

**2.2 Overview of the Adept method**

Adept was developed specifically to encourage Irish SMEs to improve their software development practices. Enterprise Ireland (representing the Irish SMEs), requested that Adept take the following factors into account:

Improvement is more important than certification and a rating is not required;

The amount of preparation time required by the company for the assessment should be minimal;

The assessment should be performed over a short period of time;

The assessment method should enable companies to select assessment in process areas that are most relevant to their business goals;

Whilst the assessment will be based upon both the CMMI**®** [8] and ISO/IEC 15504 [9] models the SPI models should be invisible to the SMEs that are being assessed.

As the main aim of the Adept method is to encourage SPI improvement based upon the generic SPI principles that are shared by both CMMI**®** and ISO/IEC:15504 we decided to base the Adept method upon relevant process areas from the CMMI**®** model and include input from the ISO/IEC:15504 model. Therefore the Adept method consists of an assessment component for each CMMI**®** process area that is deemed applicable for Irish SMEs. However, even though each assessment component adopts a CMMI**®** process area name, it will provide equal coverage of both the CMMI**®** and ISO/IEC 15504 models by containing questions that relate to ISO/IEC 15504 in addition to questions based upon the CMMI**®** model.

The process areas included in Adept are based upon the results of previous research performed by DkIT (Dundalk Institute of Technology) and Lero in relation to software processes within Irish SMEs [10, 11, 12]. Based upon this information the following 12 process areas were selected: Requirements Management, Configuration Management, Project Planning, Project Monitoring & Control, Measurement & Analysis and Process & Product Quality Assurance, Risk Management, Technical Solution, Verification, Validation, Requirements Development and Product Integration.

Any of these 12 process areas may be assessed using the Adept method. However, four are classified as mandatory - Requirements Management, Configuration Management, Project Planning, Project Monitoring & Control. The choice of mandatory process areas was based upon the overlap of three factors. Firstly, priority was given to the CMMI level 2 process areas as these are deemed to be the foundation upon which a successful software development company should be based. Secondly, priority was assigned to the process areas in which SMEs would gain most benefit [13]. Thirdly, research in Ireland has shown that specific processes are seen as important by software SME managers [10, 11, 12].

***3 Performing the Adept assessments***

Currently, we have performed an Adept assessment in three software SMEs. As cost and time issues were important for each of the companies, we restricted the on-site interviewing to one day in all cases. This meant that the assessment was limited to a maximum of six process areas as this is as many as can reasonably be covered within one day [13]. Therefore, in addition to being assessed in the four mandatory process areas, companies will also be able to choose two of the other process areas. However, one of the three companies only desired an assessment in the four mandatory process areas. The process areas assessed within the three companies are shown in Table 1.

**Table 1. Process areas assessed**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

The complete Adept method consists of eight stages, however stages 7 & 8 have yet to be performed in any of the assessed companies. In each of the assessments the assessment team consisted of two assessors who collaboratively performed the assessment. The stages were performed as described below:

Stage 1 (*Develop Assessment Schedule and Receive Site Briefing*). During this stage the assessment team met with senior management from the software company wishing to undergo an SPI assessment. The assessment team had two objectives during this stage. The first objective was to agree upon an overall schedule for the assessment and to select the six most applicable process areas. The time taken to achieve this objective varied from 30 minutes to 80 minutes across the 3 companies (see Table 2), ranging from a senior management that had prior knowledge of SPI and were committed to improving process areas that the assessment team deemed suitable, to senior management that required convincing of the benefits of SPI prior to agreeing upon an assessment or those disagreeing with the assessment team in terms of the process areas that should be assessed.

The second objective of the assessment team was to gain an understanding of the organisation to be assessed. Two of the companies provided this information solely by answering questions that were posed by the assessment team. The other organisation provided this information using a presentation combined with a question and answer session at the end of the presentation. Whilst both formats achieved the desired objective the assessment team liked the presentation approach as it provided them with structured information in relation to the organisation and this enabled them to seek additional clarification. However, as time is a key factor in relation to performing an Adept assessment it is important that the presentation is focused in the areas of the company’s structures, history, business objectives, types of ongoing projects, along with the lifecycle stage that each project has reached. If the presentation is not focused in these areas then such a presentation would be a waste of time both for the assessment team and the company (both in terms of preparation and presentation time), particularly as time would have to be spend afterwards in a lengthy question and answer session. This session lasted between 30 to 70 minutes (see Table 2) and this time really depended upon the size of the organisation, with smaller companies having fewer projects and organisational structures (e.g. Company C) to describe.

**Table 2. Overheads associated with performing stage 1 of Adept**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

This stage involved 2 assessors for each of the three companies. One senior manager participated in this stage for 2 of the companies while one senior manager and two project managers participated for the other company. Therefore the (stage 1) assessor time for each company was between 160 and 300 minutes, and the company employee time was between 80 and 240 minutes. In case of company C, they viewed the assessment as an opportunity for staff training and were keen that as many staff as possible participated.

During stage 2 (*Conduct Overview Briefing*) the lead assessor provided an overview of the Adept method to everyone within the appraised organisation who participated in various stages of the assessment. This session was key to the success of the assessment as it removed any concerns that the company personnel had in relation to both their role within the assessment and the confidentiality of their input. This overview session involved 2 assessors and between 5 to 10 company staff from the assessed organisations. In all cases it lasted approximately 1 hour (see Table 3). The same presentation was given to all three companies but the times varied slightly due to some companies asking more questions than others.

**Table 3. Overheads associated with performing stage 2 of Adept**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

Stage 3 (*Analyse Software Documentation*) provided the assessors with a brief insight into project documentation. As Requirements Management, Project Planning, Project Monitoring and Control, and Configuration Management were assessed in each of the 3 organisations the assessors requested the same type of documentation from each company. This consisted of: a typical project plan, a typical project progress report, a typical approved requirements statement and any documentation relating to the company policy on configuration management. During this stage the assessors scanned documentation firstly for existence, and secondly for structure as opposed to content. This stage was really used to develop questions based upon the documentation for stage 4.

This stage involved 2 assessors and 1 member of personnel from the assessed organisation who provided access to the documentation. Typically, the company member dedicated 1 hour to retrieving the requested documents. When the authors originally created the Adept method they proposed that the 2 assessors would each analyse the documentation for approximately 3 hours. Upon performing the actual assessment the authors discovered that 1.5 hours was adequate. Therefore we discovered that 3 person-hours of assessor time and 1 person-hour of company time are sufficient for this stage.

Stage 4 (*Conduct Process Area Interviews*) is the main part of the Adept assessment. In this stage nominated staff members (those deemed by management within the assessed organisation to be knowledgeable in relation to a particular process area) were interviewed.

In two of the companies 6 interviews were performed, with four being performed in the third company.

**Table 4. Overheads associated with performing stage 4 of Adept**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

When the authors developed the Adept method they predicted that each interview would last approximately 1 hour. However after performing three assessments it now appears that more time should be devoted to certain process areas than others. Table 4 illustrates that the project planning and the project monitoring & control process areas typically require more time than the other process areas and typically require 1.5 hours, therefore 7 hours should be scheduled in order to complete the 6 process area interviews. It should also be noted that Company C was assessed in 4 process areas as opposed to 6 process areas. Company C desired an assessment that would not only enable the chosen process areas to be assessed but they also wanted their staff to be able to ask questions of the assessors within each of the process area interviews. To enable this to be achieved within a one-day on-site timeframe it was mutually agreed, between the assessors and the senior management of company C, that only the four mandatory process areas would be assessed. Table 4 illustrates that the individual process area interview were therefore longer for company C than the other two companies. It can also be noted from Table 4 that company A dedicated as few company participants as possible in order to perform the assessment whereas company C viewed the assessment as an opportunity to educate staff and therefore 4 staff out of a total staff pool of 7 participated in each interview session. It can also be noted from Table 4 that in the case of the process area interviews that were common (the same set of scripted questions were used) to both Companies A and B that all the interviews lasted longer for company B. In 2 out of the 4 interviews company B had more participants and this could have impacted the duration of the interview, however whenever the interviews contained the same number of participants this was also the case. The authors report that this was due to the fact that Company B was a larger organisation and had more ongoing projects and therefore more project teams and a greater number of practices within each process area and therefore this required a more extensive question and answer session.

Two assessors participated in each process area interview. This equated to between 12 person-hours and 20 minutes of assessor time for a company A, 14 person-hours of assessor time for company B and 11 person-hours and 50 minutes of assessor time for company C. In relation to company time 13:50, 21 and 23:40 person-hours were consumed for companies A, B and C respectively.

When performing the assessments the authors also scheduled the process area interviews in the natural sequence of the software development lifecycle. This helped the assessors to develop an accurate profile of the software development practices adopted by a company and enabled the responses from process areas’ interviewees earlier in the day to be cross-referenced in later interviews.

During each of the process area interviews, the lead assessor asked a combination of pre-defined and follow-up questions while the other assessor made notes. Additionally the lead assessor used an Excel based tool to make an initial judgement about the responses by judging them against a discrete set of values – Red (not practiced), Amber (partially practiced), Yellow (largely practiced) and Green (fully practiced). This enabled the opinions of the questioner and not just the note-taker to be recorded for subsequent review in stage 5.

Stage 5 (*Generate Appraisal Results and Create the Findings Report*) was an off-site stage. This involved a both of the assessors working together to agree upon a findings report. The output of this stage was a findings report for each company that consisted of a list of strengths, issues and recommendations for each of the assessed process areas. The findings reports were developed through the assessors firstly focusing upon the scores produced by the Adept tool and initially searching for particular areas of extreme (i.e. All red or all green) and then reviewing the associated interview notes and the for each of the 6 assessed process areas. This stage involves 2 assessors collaborating together for 5:30, 6 and 4:30 hours respectively for Company A, B & C. As only 4 process areas were assessed in company C the production of the findings report took considerably less time. It seemed to take approximately 1 hour to document the findings report of each process area. Therefore a total 11,12 and 9 person-hours of assessor time was required for these stage in relation to companies A, B and C respectively.

Stage 6 (*Deliver the Findings Report*) involved presenting the findings report to the staff in the assessed organisation who participated in the interviews (see Table 5). Both assessors participated in these presentations. The briefing session lasted between 40 to 70 minutes for each of the three assessed companies. As there was only 4 process areas assessed in company C its findings presentation was the shortest. The findings presentation for company B was the longest due to the fact that more projects were assessed and more staff asked questions during this presentation than in any of the other company presentations.

**Table 5. Overheads associated with performing stage 6 of Adept**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

Stage 7 (*Develop a SPI Path with the Company*) involves collaborating with staff from the appraised company to develop a roadmap that will provide guidance to the appraised company in relation to practices that will provide the greatest benefit in terms of the company’s business goals. This stage was not performed with any of the three companies.

Stage 8 (*Re-assess the SPI Path and Produce a Final Report*) involves revisiting the appraised company approximately 6 months after the completion of stage 7 and reviewing progress against the SPI path that was developed in stage 7. The outcome of this stage will be an updated SPI path and a final report detailing the progress that has been accomplished along with additional recommendations. This stage was not performed with any of the three companies.

***4 Analysis of Assessment Effort***

In comparing the results in Table 6, and to ensure a like-for-like comparison, we have used only the 4 process areas in Stage 4 that were common to the 3 assessed companies.

**Table 6. Summary of the Adept Overheads for the Three Companies**

**PRESENTED AFTER REFERENCES AS PER THE GUIDELINES**

All other Adept stages, 1–3 and 5–6, were common to all 3 companies. In carrying out the assessments we can see that the amount of company time involved ranged from 1425 minutes (c.24 hours) to 2510 minutes (c.42 hours) averaging at 2043 minutes (c.34 hours). Company B generated the highest value as the greatest number of its participants took part in the process. If we assume a company utilisation rate of 7 hours per staff day, then the average commitment for the 4 process area assessments, c.34 hours, is equivalent to 1 staff week.

The range of assessor time is narrower, 1740–2060 minutes (29-34 hours), as the differences can be explained by company A having the fewest number of employee participants, which reduced the number of queries directed to the assessors, and company B having the largest number of participants which generated the greatest number of questions. Assuming a similar utilisation rate for an assessor, 7 hours per staff day, then the assessor cost average for the 4 process area assessment, 31 hours, is also equivalent to one staff week.

Based on these figures we can attempt to determine the actual cost for the 4 process area assessment. Determining an accurate cost for the assessment clearly depends on the company’s own costing model, and the assessor fee. If we take a company cost figure of €350 euros per staff day, and an assessor cost of €750 euros per day, we arrive at a total cost for the assessment of €5500. This figure is however, something of an underestimate as it includes only time costs and makes no provision for travel and hotel expenses for the assessors which will likely be incurred during the assessment. It also does not include the cost for Adept stages 7 and 8 which involve working with the company on developing an SPI initiative based on the assessment results and the subsequent follow-up visit to review the success, or otherwise, of that SPI activity.

***5 Discussion on the Significance of the Overhead Costs***

There is little information contained in the literature regarding the actual cost of engaging in assessment-based SPI, especially at the small company level. Most of what is reported relates to larger scale CMM or CMMI SCAMPI-based appraisal. However, the cost of implementing CMM/CMMI-based improvement can be very high, from in excess of 100,000 dollars [14], 180 person-days on process redefinition, 70 person-days on training and 20 person-days on evaluations on a programme to secure CMM Level 2 accreditation [15]), to 45,000 dollars for the initial assessment activities and 400,000 dollars to move from level 2 to level 3 [16]. Herbsleb *et al.* [17] conducted a multiple case study of companies who had experienced success with CMM. However, the majority of those companies felt that implementing CMM had cost more than expected, leading the SEI-employed authors to concede that CMM is neither a cheap nor quick fix. In addition, CMM can negatively impact a small software company’s competitive potential [18]. Brodman and Johnson, [19] report a number of resource-related difficulties that small companies have in attempting to implement the CMM, a fact conceded by the CMM’s own proponents [20].

The heavy expenditure required to engage in full CMM/CMMI-based improvement, documented above, demonstrates the difficulties that small companies face in trying to engage in SPI. Most small companies have very limited finances and so a resource-intensive SPI initiative is clearly unattractive. Our objective in developing Adept was to provide a cheaper SPI alternative to smaller organisations. The feedback in this regard from the companies assessed has been largely positive both from the economic perspective regarding assessment cost and the actual benefits which companies felt flowed from the process and subsequently.

***6 Conclusion and Future Work***

This paper aims to show the true nature of SPI assessment in small software companies and the costs incurred by the companies involved. All of the companies reported major benefit from the assessments which have been carried out within the last year. It is our intention to make further contact with the companies concerned in the near future to see how their SPI activity has progressed since the assessments. We believe that by showing the real cost of engaging in assessment-based SPI, companies can be more informed about undertaking initiatives and can plan and budget accordingly. Only by doing a true cost-benefit analysis in this way can companies measure the success of SPI initiatives.

We plan to continue to promote the Adept approach and intend to expand the offering through e-Adept, a web-based service, which will enable company self-assessment, with remote assessor support, using the Adept framework. Initial company discussions indicate significant interest in an on-line assessment programme which can reduce assessment formality and cost even further, and allow more regular company, team or project self-examination.

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**Table 1. Process areas assessed**

|  |  |  |
| --- | --- | --- |
| **Company A**  | **Company B**  | **Company C**  |
| Requirements Management | Requirements Management | Requirements Management |
| Project Planning | Project Planning | Project Planning |
| Project Monitoring & Control | Project Monitoring & Control | Project Monitoring & Control |
| Configuration Management | Configuration Management | Configuration Management |
| Technical Solution | Verification |  |
| Product Integration | Risk Management |  |

**Table 2. Overheads associated with performing stage 1 of Adept**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **A** | **B** | **C** |
| Objective 1 : Assessment schedule meeting duration (mins) | 30 | 80 | 50 |
| Objective 2 : Site Briefing duration (mins) | 50 | 70 | 30 |
| Time taken for stage 1 meetings (mins) | 80 | 150 | 80 |
| No. of Assessors | 2 | 2 | 2 |
| No. of Company Participants | 1 | 1 | 3 |
| Total Assessor time for stage 1 (mins) | 160 | 300 | 160 |
| Total Company time for stage 1 meetings  | 80  | 150 | 240 |

**Table 3. Overheads associated with performing stage 2 of Adept**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **A** | **B** | **C** |
| Stage 2 : Conduct Overview Briefing (mins) | 45 | 70 | 55 |
| No. of Assessors | 2 | 2 | 2 |
| No. of Company Participants | 7 | 10 | 5 |
| Total Assessor time for stage 2 (mins) | 90 | 140 | 110 |
| Total Company time for stage 2 meetings  | 315 | 700 | 275 |

**Table 4. Overheads associated with performing stage 4 of Adept**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company**  | **A** | **B** | **C** |
| **Process area interview time (mins)**  |  |  |  |
| **Requirements Management** interview time (mins) | 65 (1) | 70 (3) | 80 (4) |
| **Project Planning** interview time (mins) | 80 (3) | 90 (3) | 105 (4) |
| **Project Monitoring & Control** interview time (mins) | 75 (3) | 85 (3) | 100 (4) |
| **Configuration Management** interview time (mins) | 45 (2) | 55 (3) | 70 (4) |
| **Technical Solution** interview time (mins) | 55 (2) | N/a | N/a |
| **Product Integration** interview time (mins) | 50 (2) | N/a | N/a |
| **Verification** interview time (mins) | N/a | 65 (3) | N/a |
| **Risk Management** interview time (mins) | N/a | 55 (3) | N/a |
| **Total *Company interview time (mins)*** | 830 | 1260 | 1420 |
| Interview time (mins) | 370 | 420 | 355 |
| No. of Assesors | 2 | 2 | 2 |
| **Total Assessor time (mins)** | 740 | 840 | 710 |

**Table 5. Overheads associated with performing stage 6 of Adept**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **A** | **B** | **C** |
| Stage 6 : Deliver the findings report (mins) | 50 | 70 | 40 |
| No. of Assessors | 2 | 2 | 2 |
| No. of Company Participants | 7 | 10 | 5 |
| Total Assessor time for stage 6 (mins) | 100 | 140 | 80 |
| Total Company time for stage 6 meetings  | 350 | 700 | 200 |

**Table 6. Summary of the Adept Overheads for the Three Companies**

|  |  |  |
| --- | --- | --- |
| **Adept Stage** | **Process Area** | **Company Time (CT) /Assessor Time (AT)** |
|  |  | **A** | **B** | **C** |
|  | **CT** | **AT** | **CT** | **AT** | **CT** | **AT** |
| Stage 1  |  | 80  | 160 | 150 | 300 | 240 | 160 |
| Stage 2  |  | 315 | 90 | 700 | 140 | 275 | 110 |
| Stage 3  |  | 60 | 180 | 60 | 180 | 60 | 180 |
| Stage 4  | *Requirements Management* | 65 | 130 | 210 | 140 | 320 | 160 |
|  | *Project Planning* | 240 | 160 | 270 | 180 | 420 | 210 |
|  | *Project Monitoring & Control* | 225 | 150 | 255 | 170 | 400 | 200 |
|  | *Configuration Management* | 90 | 90 | 165 | 110 | 280 | 140 |
| Stage 5  |  |  | 660 |  | 720 |  | 540 |
| Stage 6  |  | 350 | 120 | 700 | 120 | 200 | 120 |
| **Total Time (Mins)** |  | **1425** | **1740** | **2510** | **2060** | **2195** | **1820** |